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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/752,685	01/03/2001	Shane J. Trapp	M4065.0369/P369	9753
24998	7590	07/11/2005	EXAMINER	
DICKSTEIN SHAPIRO MORIN & OSHINSKY LLP			CHEN, JACK S J	
2101 L Street, NW			ART UNIT	
Washington, DC 20037			PAPER NUMBER	
			2813	
DATE MAILED: 07/11/2005				

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/752,685

Applicant(s)

TRAPP, SHANE J.

Examiner

Jack Chen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 28 April 2005.
- 2a) ☐ This action is **FINAL**.                      2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-13, 15-25, 36-39, 41-46 and 64-70 is/are pending in the application.
- 4a) Of the above claim(s) 1-13 and 15-25 is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 36-39, 41-46, 64-70 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All    b) ☐ Some \*    c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892)   | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

### **DETAILED ACTION**

This Office Action responses to communication dated on April 28, 2005.

Applicant's election with traverse of the invention of Species II, with claims 36-39, 41-46 and 64-70 indicated by Applicant to read thereon, in the reply filed on 28 April 2005 is acknowledged. The traversal is on the ground(s) that the Species are readily evaluated in one search without placing undue burden on the Examiner. This is not found persuasive because this proposed process shows at least two different species that would require a diversity field of search and it would require undue burdensome search to examine all different species.

The requirement is still deemed proper and is therefore made FINAL.

Claims 1-13 and 15-25 are withdrawn from further consideration pursuant to 37 CFR 1.142(b), as being drawn to a nonelected Species, there being no allowable generic or linking claim.

### ***Claim Rejections - 35 USC § 103***

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

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**1. Claims 36-39, 41-46 and 64-70, as being best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Tan et al [US 6,140,168] in view of Ding et al [US 5,814,563].**

Tan et al, Figs 1A-1D and cols. 1-6, discloses a method for forming a self-aligned contact opening (124, fig 1D) in an insulative layer (114b) formed over a substrate comprising steps:

providing the substrate (100, fig 1A) comprising adjacent gate stacks being formed thereon, the adjacent gates stacks comprising opposed side wall spacers (108) which have been formed over the adjacent gate stacks *[claims 36, 64]*;

forming the insulative layer (114, fig 1B) over the substrate, the adjacent gate stacks and the side wall spacers which have been formed over the adjacent gate stacks *[claims 36 and 64]*;

forming a patterned photoresist mask layer (116, fig 1B) over said insulative layer *[claim 36]*;

contacting and etching the insulative layer through an aperture (120, fig 1C-1D) in the patterned photoresist mask layer using a plasma etchant mixture comprising fluorocarbon (CHF<sub>3</sub> and CF<sub>4</sub>, col. 3 lines 42-55) *[claims 36 and 66]* so as to form the self-aligned contact opening (124, fig 1D) without an etch stop *[claims 42 and 64]* in the insulative layer located between the adjacent gate stacks and the opposed side wall spacers aligning the self-aligned contact opening to the substrate *[claim 43]*, wherein said sidewall spacers are not etched and defines at least in part of said self-aligned contact opening (fig 1D) *[claim 64]*;

removing the patterned photoresist mask layer after said contacting and etching *[claim 46]*.

Tan et al does not teach: 1) using the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon of a ratio flow rate of the fluorocarbon to ammonia of 2:1 to 40:1 with the flow rate of said ammonia of at least about 2 sccm to form the self-aligned contact opening at a temperature of about  $-50$  to  $80^{\circ}\text{C}$  with further forming a protective layer over the opposed side wall spacers of the adjacent gate stacks; and 2) depositing a conductive plug inside said self-aligned contact such that said conductive plug is separated from said side opposed side wall spacers by said protective layer.

Regarding to 1), Ding et al, figs 1-7 and col 1-14, discloses a method of forming an opening in an insulating layer (20, fig 1d) formed over a substrate (25,32,34, 36, fig 1d) in a semiconductor device comprising etching said insulative layer with an etchant composition consisting essentially of ammonia ( $\text{NH}_3$ ) and at least one of fluorocarbon ( $\text{CHF}_3$  and  $\text{CF}_4$ ) so as to form said opening wherein flow rate ratio of said at least one fluorocarbon to said ammonia is from about 4:1 to about 10:1 and said flow rate of said ammonia is at least about 2 sccm (col 11-12); said etching includes plasma etching, is performed through a patterned photoresist mask without forming an etch stop, and is performed at a temperature range of about  $-50$  to about  $80^{\circ}\text{C}$  (see examples). *Regarding the flow rate of ammonia (2 sccm to about 6 sccm), see fig. 4 (Ding et al.), which is within the scope of the instant invention, also see col. 8, lines 1-3 and col. 10, lines 25-40.* Ding et al discloses the etching is performed within a range temperature of about  $0$ - $50^{\circ}\text{C}$  (e.g.  $50^{\circ}\text{C}$ , col 6 lines 51-67). Ding et al discloses the etching is performed at an operating pressure of about 40-50 mTorr (e.g. 50 mTorr, col 5 lines 45-65). Ding et al discloses the etching is performed at the flow rate of  $\text{CF}_4$  of about 15-20 sccm (e.g 18 sccm, col 10 lines 31-

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33). Ding et al discloses the etching is performed at the flow rate of  $\text{CHF}_3$  of about 35-45 sccm (e.g. 40 sccm, col 10 lines 24-26).

Ding et al disclosed using ammonia in addition to fluorocarbon with the flow rate ratio of the fluorocarbon to ammonia of 2:1 to 40:1 and the flow rate of ammonia of at least about 2 sccm for plasma etching the insulative layer at a temperature of about  $-50$  to  $80^\circ\text{C}$  would provide a better etch process with a high etch rate and an improved etch selectivity (see col 5-12). Ding et al also teaches using the plasma etchant mixture consisting essentially fluorocarbon and ammonia would form an opening with a protective layer being formed on sidewall of the opening (fig 1b or 1d). Therefore, it would have been obvious for those skilled in the art to modify the process of Tan et al by using the plasma etchant mixture essentially consisting of ammonia and said fluorocarbon with the flow rate ratio and temperature as being claimed, per taught by Ding et al, to etch the self-aligned contact with a better etch rate and improved etch selectivity without an etch stop. In addition, those skilled in the art would recognize that combination of the process of Tan et al in view of Ding et al will form a protective layer containing nitrogen over the opposed side wall spacers in the self-aligned contact opening.

Regarding to 2), depositing the conductive plug inside the self-aligned contact opening is known in the art for forming electrical connection in a semiconductor device. In addition, Tan et al teaches forming a self-aligned contact opening is for forming electrical connection between source/drain region and metal layer [see col 2 lines 15-23]. It would have been obvious for those skilled in the art to modify the process of Tan et al in view of Ding et al by depositing the conductive plug inside the self-aligned contact opening wherein the conductive plug separated

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from the sidewall spacers by the protective layer since the usage of the plasma etchant mixture consisting essentially of ammonia ( $\text{NH}_3$ ) and at least one of fluorocarbon to provide electrical connection between source/drain region to certain location of the semiconductor device to operate the device.

Tan et al (col 3 lines 42-50) further teaches using the fluorocarbons essentially consisting of  $\text{CF}_4$  and  $\text{CHF}_3$  for etching the insulative layer. Ding et al teaches  $\text{C}_2\text{H}_2\text{F}_2$  can be added to the fluorocarbon mixture for etching the insulative layer. Therefore, it would have been obvious for those skill in the art to use the fluorocarbon mixture comprising  $\text{CF}_4$ ,  $\text{CHF}_3$ , and  $\text{CH}_2\text{F}_2$  to etch the insulative layer in the process of Tan et al in view of Ding et al. In addition, using the fluorocarbons comprising  $\text{CF}_4$ ,  $\text{CHF}_3$  and  $\text{CH}_2\text{F}_2$  has been known in the art for etching the insulative layer. The selection of a known material based on its suitability for its intended use supported a prima facie obviousness determination in *Sinclair & Carroll Co., Inc. v. Interchemical Corp.*, 325 U.S. 327, 65 USPQ 297 (1945). "Reading a list and selecting a known compound to meet known requirements is no more ingenious than selecting the last piece to put in the last opening in a jig - saw puzzle." 65 USPQ at 301.).

With respect to claims 36, 39, 41, 44-45, 64-70, claimed ranges of temperature, flow rates, flow rate ratios in the etching step and thickness, absent evidence of disclosure of criticality for the range giving unexpected results are considered to involve routine optimization while has been held to be within the level of ordinary skill in the art. As noted in *In re Aller* 105 USPQ233, 255 (CCPA 1955), the selection of reaction parameters such as temperature and concentration would have been obvious. See also *In re Waite* 77 USPQ 586 (CCPA 1948); *In re Scherl* 70 USPQ 204 (CCPA 1946); *In re Irmischer* 66 USPQ 314 (CCPA 1945); *In re Norman*

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*66 USPQ 308 (CCPA 1945); In re Swenson 56 USPQ 372 (CCPA 1942); In re Sola 25 USPQ 433 (CCPA 1935); In re Dreyfus 24 USPQ 52 (CCPA 1934).*

### ***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Jack Chen whose telephone number is (571)272-1689. The examiner can normally be reached on Monday-Friday (9:00am-6:30pm) alternate Monday off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl W. Whitehead can be reached on (571)272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).



Jack Chen  
Primary Examiner  
Art Unit 2813

July 10, 2005